Stand-Alone EEDTS Pro

with controller addressing circuit

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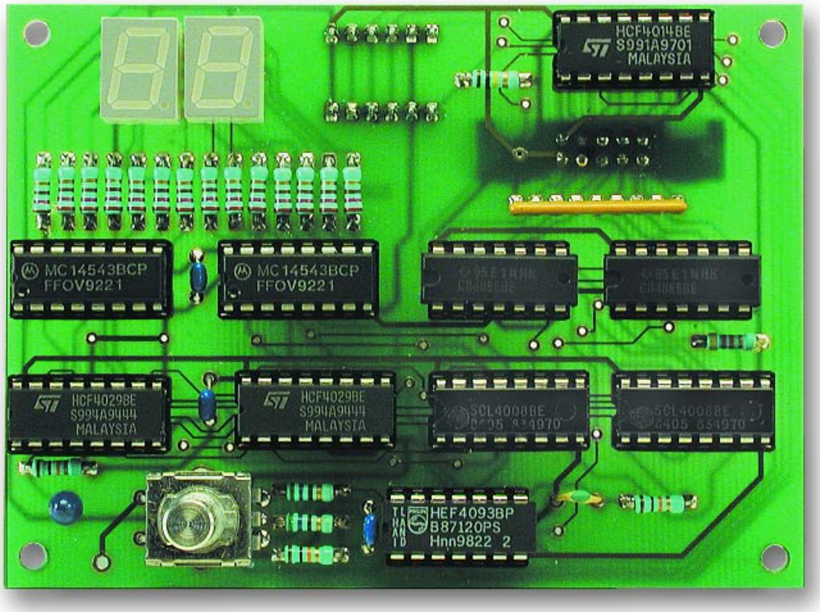
Not every user of the EEDTS Pro system needs to control his model trains using a PC. This article describes how the system can be used stand-alone and what is required. We also present a deluxe address programming circuit for your manual controllers.

Even shortly after the introduction of EEDTS Pro, it was evident that some users needed to be able to control the system without using a PC. One of the most frequently asked questions was whether the earlier EEDTS keypad could also be adapted to be used with the system and whether a keypad control would be coming. Another question that arose with regard to stand-alone operation of the controller was whether the ‘fixed’ addresses of the manual controllers could be changed without having to use a PC.

You might think that it shouldn’t be so difficult to add these functions to the controller, but as can be seen from the old EEDTS address programmers and keypad circuit, such circuitry uses quite a few processor I/O lines or special I/O components.

That leads to another problem: practically all of the I/O lines of the EEDTS Pro controller are already in use, and the few that are not used are not routed to external connectors. The question was thus whether it was nevertheless possible to implement the above-mentioned functions within the current concept.

The solution was found in the S88 bus. This controller interface, which is quite busy collecting return data via the track when PC control is used, has precious little to do in stand-alone operation. That forms a good argument for using it for our purposes, with the additional advantage that absolutely no changes are necessary on the main controller circuit board. At the same time, we immediately gain access to 64 8-bit input channels, which is more than sufficient for our plans.



Starting up in stand-alone mode

The controller cannot decide on its own whether stand-alone or normal operation is desired. Its preference is for normal operation, in which all 64 EEDTS return signallers (or 32 Märklin S88 modules) are seen as return signallers (with addresses 1–64) that can be queried via the PC.

However, if the F0 key of manual controller 1 is held pressed while the main controller is started up or reset, the interpretation of the S88 bus changes as follows:

– the first 32 (8-bit) modules are

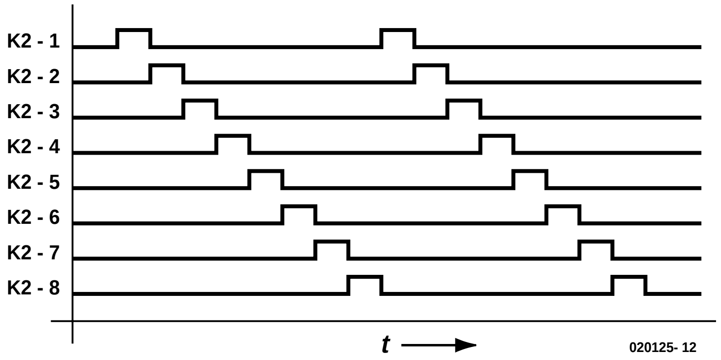


Figure 1. Timing diagram for the selection lines.

reserved for address programming and the keypad;

- the last 32 (8-bit) modules can still be used as needed as return modules (with addresses 1–32).

Controller addressing

Simple controller addressing

With the new master controller, locomotive addresses can be set within the range of 1 to 255. For a return module (8 bits), all of these addresses can be set in binary form, and in principle eight of them are needed to address all eight manual controllers. Although reserving eight modules for controller addresses would have the advantage of making it very easy to set the addresses, it would drastically reduce the number of possible keypad/return modules.

However, there are other options. Since address setting is intended to be done near the master controller, we can take advantage of the eight controller selection lines, which can be found on connector K2 of the master controller circuit board.

The controller selector lines are normally all Low, but when one of the eight controllers is selected, the processor sets one of these lines High (see **Figure 1**). During the selection interval, the function inputs are read, and thus it takes only a small additional effort to look at the S88 bus at the same time to see whether a new address for the controller may be present there.

To try out address setting, all you actually need is a single EEDTS detector module. The circuit shown in **Figure 2** shows this quite clearly.

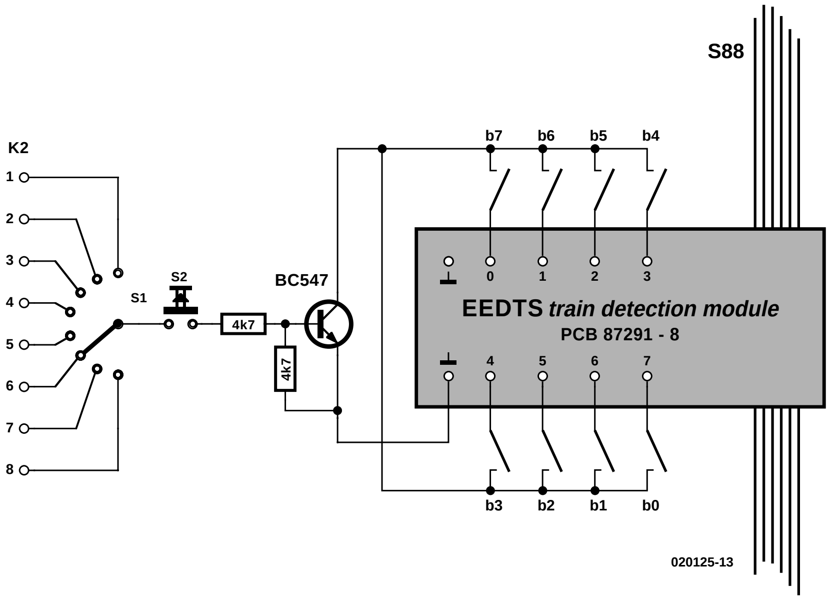


Figure 2. The simplest version of the address setting circuit.

In order to transform a normal train detector module into a genuine address programming module, you need a rotary switch with one wiper contact and eight positions. Although the well-known Lori switch has twelve positions, it can be converted into an eight-position switch by relocating the end stop.

This switch is then used to select one of the eight manual controllers, following which a binary address between 1 and 255 is set using switches b0–b8. Don't forget that the most significant bit (b7) must be connected to input 0!

Now hold pushbutton switch S2 depressed for a few seconds. After this, the address of the selected controller will have been modified. Make sure that the same address is not assigned to more than one manual controller. The master controller will allow this, but it will lead to confusing results on the track.

The purpose of the transistor with the two resistors is to invert the controller selection signal.

This train detector module should be the first module connected to the controller. If you do not need to modify the addresses of the manual controllers, but you do want to use keypad functionality, a 'dummy' train detector module (which is a train detector module with nothing connected to its inputs) must be connected at this location. (In Figure 2, everything except the train detector module has been omitted.)

When modified manual controller addressing is used, the addresses are always 'soft programmed'. This means that the settings are obliterated by a reset, so the master controller restarts with the default addresses.

Deluxe manual controller addressing

Quickly programming a binary address into your favourite manual controller so you can command an express train to stop before an impending collision is something best left to 'bit fanatics' with nerves of steel. However, for model railway owners with lower stress tolerance, we can offer a more luxurious version of the address programmer.

This version is shown in **Figure 3**. By and large, this circuit does the same thing as the simple version. An 8-position switch is used once again to select the controller, and even the pushbutton switch is still present, although here it is hidden inside the rotary switch that is used (contacts 4 and 5 are closed if you press on the knob).

This rotary switch (S1), which is called a 'rotary encoder', consists primarily of two changeover contacts with a common connection (pin 1). If the knob is turned to the right, as it moves between two positions contacts

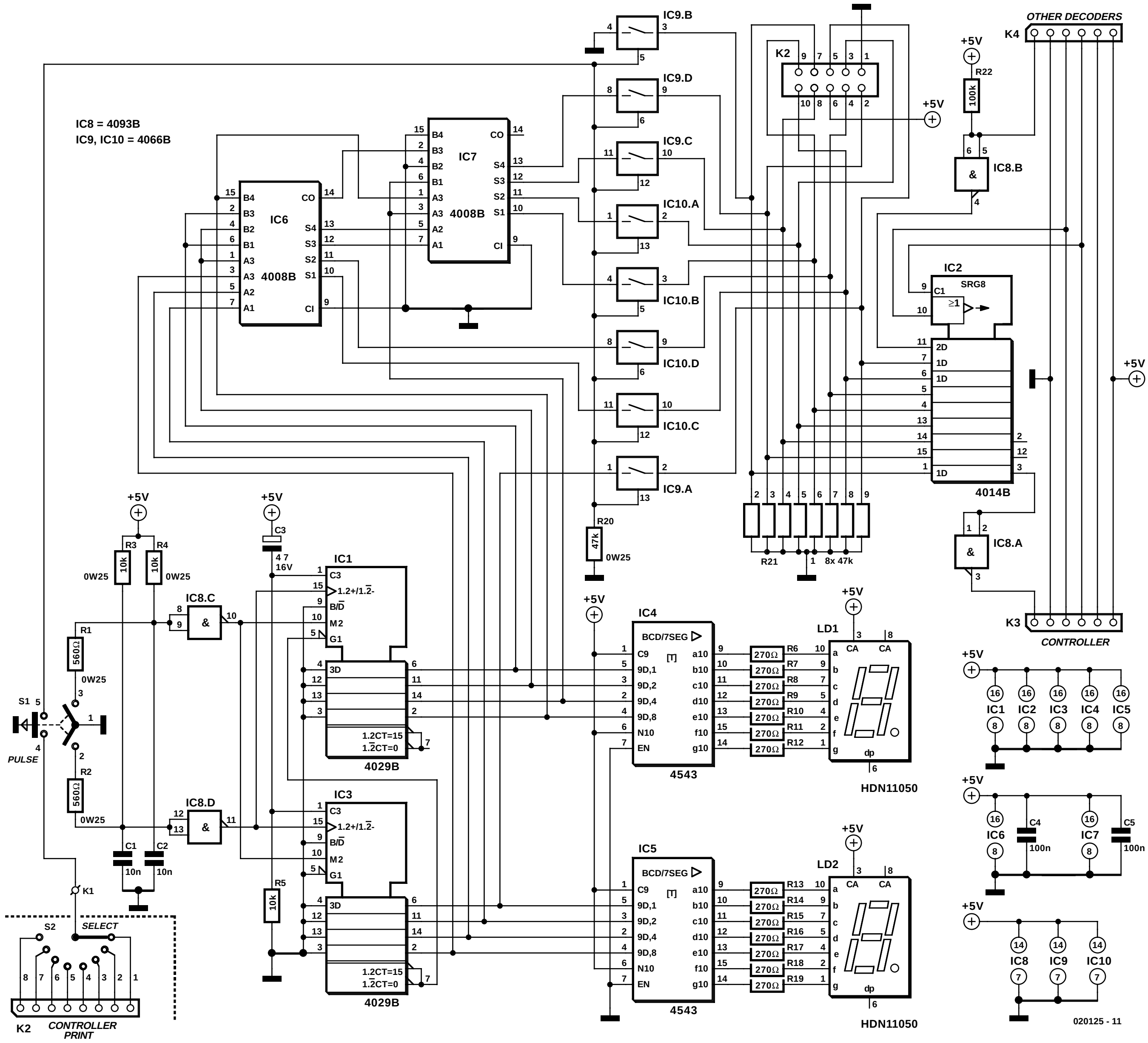


Figure 3. Schematic diagram of the controller address programmer.

1 and 3 close first, followed by contacts 1 and 2. Then contacts 1 and 3 open, followed by contacts 1 and 2. If the knob is turned to the left, as it moves between two positions contacts 1 and 2 close first, followed by contacts 1 and 3. Clearly, when the switch is being rotated to the right contacts 1 and 2 are still open when contacts 1 and 3 close, while with rotation to the left contacts 1 and 2 will already be closed.

Little more is needed to cause the 4049 CMOS synchronous counters (IC1 and IC3) to count up or down. R1–R4, C1 and C2, followed by Schmitt triggers IC8c and IC8d, are needed to produce reliable pulses from the bouncing contacts.

The two 4029 counters form a two-digit decade counter, so values between 1 and 99 can be set using the rotary switch. You might consider this to be a drawback, since after all, the simple version can set 255 addresses. However, this is an intentional choice, with the primary reason being that rotating the knob through 100 addresses (or at most 50 if you approach things right) is just about the limit of most people's patience. Also, since we're using a standard logic family, more than three times as many components would otherwise be required.

Two type 4543 BCD-to-7-segment decoder/drivers are used to convert the two decades from the 4029 counters into signals that drive two 7-segment displays (LD1 and LD2) via resistors R9–R16.

We now have easily readable addresses between 0 and 100 on a display, but what we ultimately need is to have the two 4-bit BCD codes from the 4029s converted into an 8-bit binary code that master controller can understand. This trick is performed by two 4-bit binary full adders (type 4008), whose operation we will not attempt to explain here. Suffice it to say that we have here is a sort of primordial computer IC.

The 8-bit binary code can only be

applied to shift register IC2 (a 4014) if the controller in question is being read out. The adder outputs are thus connected to the parallel inputs of the shift register via bilateral switches (IC9 and IC10).

To use the deluxe controller address programmer, first select a controller using 8-position switch S2. Then select an address using the rotary switch and press the knob to copy the address to the controller.

Super-deluxe controller addressing

The deluxe controller address programmer has advantage that the controller address can be easily seen while the controller is being programmed, but it also has some disadvantages, such as the fact that there is no permanent display of the addresses assigned to the manual controllers. It also requires a bit of extra work, since the controller must first be selected with a switch before it can be programmed.

The super-deluxe controller address programmer does not have these disadvantages, and it allows the addresses of up to eight

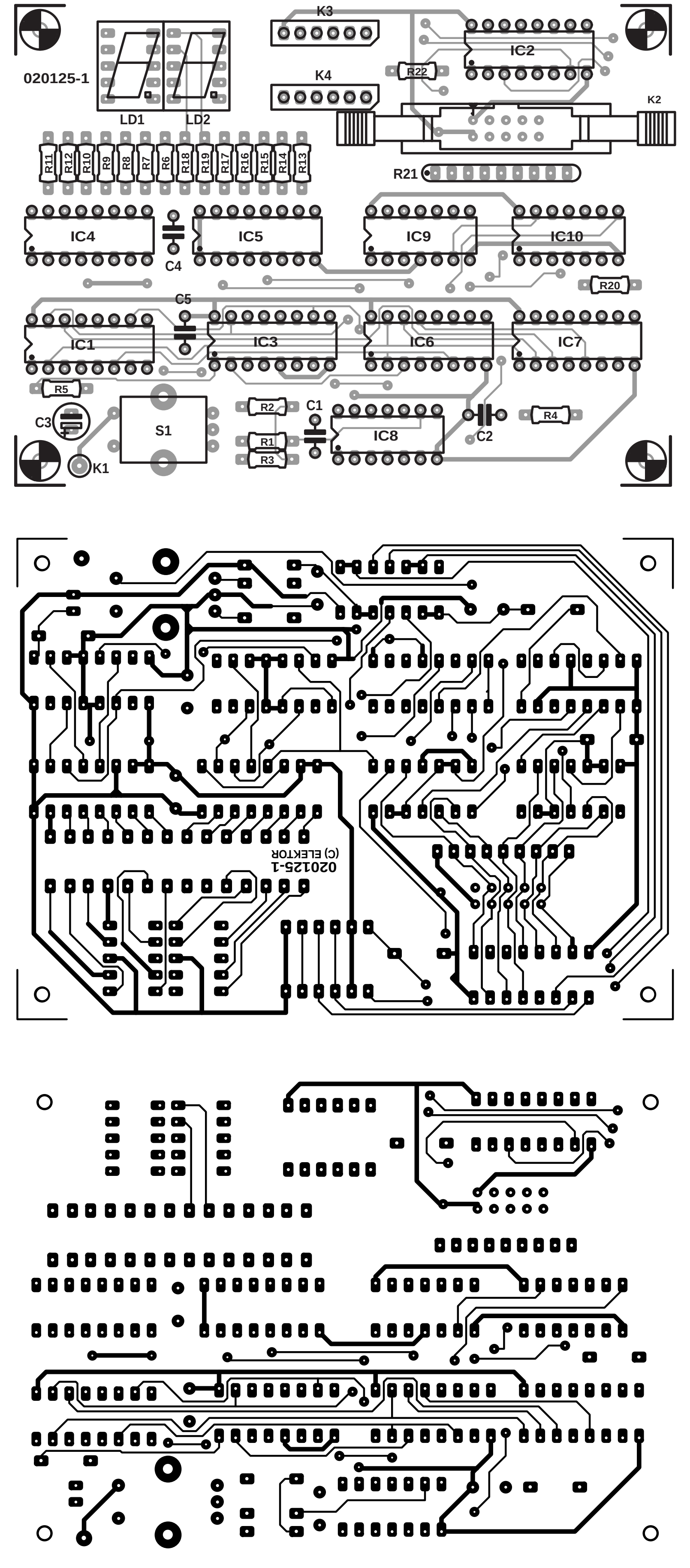


Figure 4. Double-sided printed circuit board layout for the circuit shown in Figure 3.

COMPONENTS LIST

Resistors:

R1,R2 = 560Ω
R3,R4,R5 = 10kΩ
R6-R19 = 270Ω
R20 = 47kΩ
R21 = 8-way 47kΩ SIL array
R22 = 100kΩ

Capacitors:

C1,C2 = 10nF, lead pitch 5mm
C3 = 4µF7 16V radial
C4,C5 = 100nF, lead pitch 5mm

Semiconductors:

IC1,IC3 = 4029
IC2 = 4014
IC4,IC5 = 4543
IC6,IC7 = 4008
IC8 = 4093
IC9,IC10 = 4066
LD1,LD2 = HDN1105 or LTS4801E

Miscellaneous:

S1 = rotary encoder, upright model, Conrad Electronics # 705594
S2 = rotary switch, 1 pole, 8 positions
K3,K4 = 6-way SIL header*
K2 = 10-way boxheader*
PCB, order code **020125-1** (see Readers Services)

* = mount at underside of board

manual controllers to be independently set while displaying the current locomotive address of each controller!

The only thing you have to do is to build two to eight copies of the deluxe address programmer board.

The selector switch can now be discarded, with each input instead being connected directly to one pin of connector K2 on the master controller board. In addition, all of the address programming boards are interconnected via the K2 connectors on the individual programming boards, using a 10-way flat cable and suitable headers (you can use a 1.4-m length of 10-strand flat cable with a total of eight headers attached every 20 cm). This cable supplies power to all of the programming boards and provides a sort of internal bus for the addresses to be set.

Naturally, only one address programming board (the master) can be fully populated and connected to the S88 bus. On all of the other address programming boards (the slaves), IC2 is not fitted, R21 must be omitted and connectors K3 and K4 may be omitted.

Many different combinations are possible, such as using only four address programming boards for four manual controllers (in which case it is recommended to ‘hard code’ the addresses of controllers 5 through 8 to 0, to avoid selecting an address that is already used by one of these controllers), or even a combination of one address programming board with a 4-position switch for four manual controllers (5–8, for example) and four address programming boards for direct address programming of manual controllers (for example 1–4).

The double-sided printed circuit board (**Figure 4**) is designed to have K2, K3 and K4 fitted on the back side (solder side), so the board with the rotary switch and display can be fitted directly behind a front panel (see **Figure 5**).

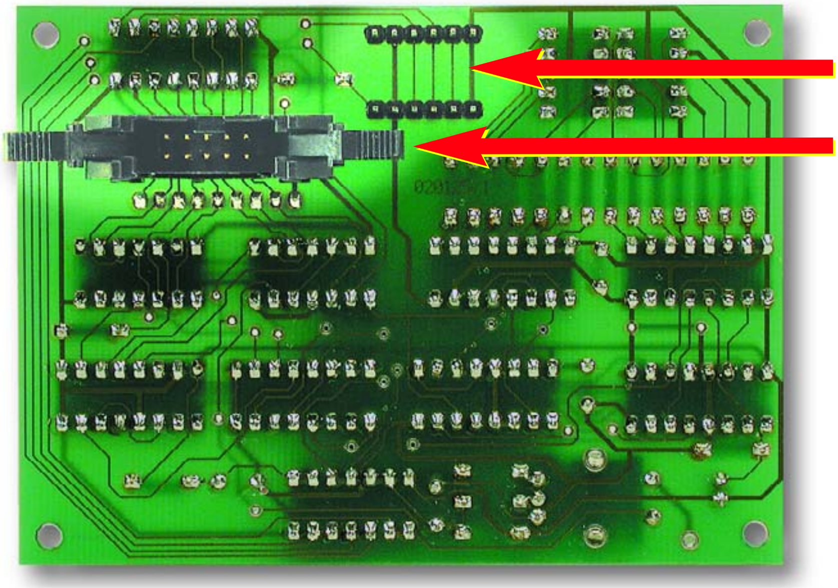


Figure 5. Detail of the connectors fitted to the solder side of the board.

EEDTS Pro keypad

Take four red pushbutton switches and four green pushbutton switches and connect them to an EEDTS train detector module (**Figure 6**) that is connected to the EEDTS Pro S88 bus. *Voilà* – you now have a genuine keypad!

This approach is primarily interesting for modellers who build ‘real’ control panels with physical pushbuttons, since in this concept the switches are not located on the printed circuit board, but instead are connected using wires. With the arrangement shown in Figure 6, up to 248 pushbuttons (31 × 8) could be built into such a panel for controlling loads. The entire control panel can be connected to the master controller using only five wires!

For people who regret the fact that Märklin no longer makes a switchboard, this represents a very attractive alternative.

As noted in the discussion of the address setting, the first module is reserved for setting addresses and must be present in all cases. After it, you can put together a chain of keypad modules.

Märklin S88 modules may also be used for the keypad modules (see **Figure 7**).

The first module following the address programming module has a fixed address of ‘1’, the second ‘2’ and so on, up to ‘31’.

This approach has been chosen for the sake of simplicity. Note that Märklin S88 modules occupy two

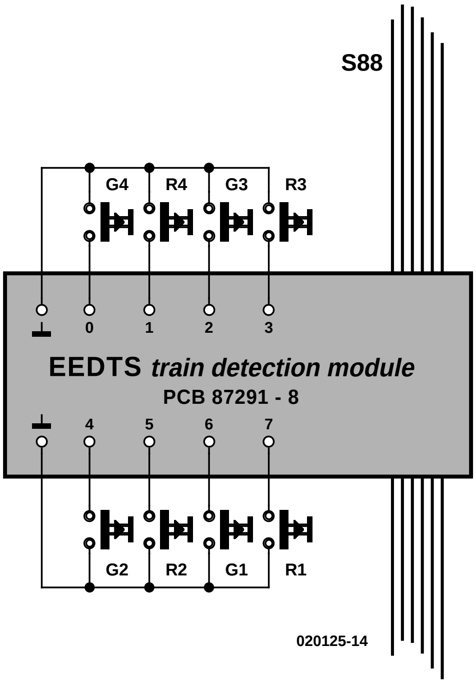


Figure 6. An EEDTS Pro keypad can be built using eight pushbutton switches and a train detector module.

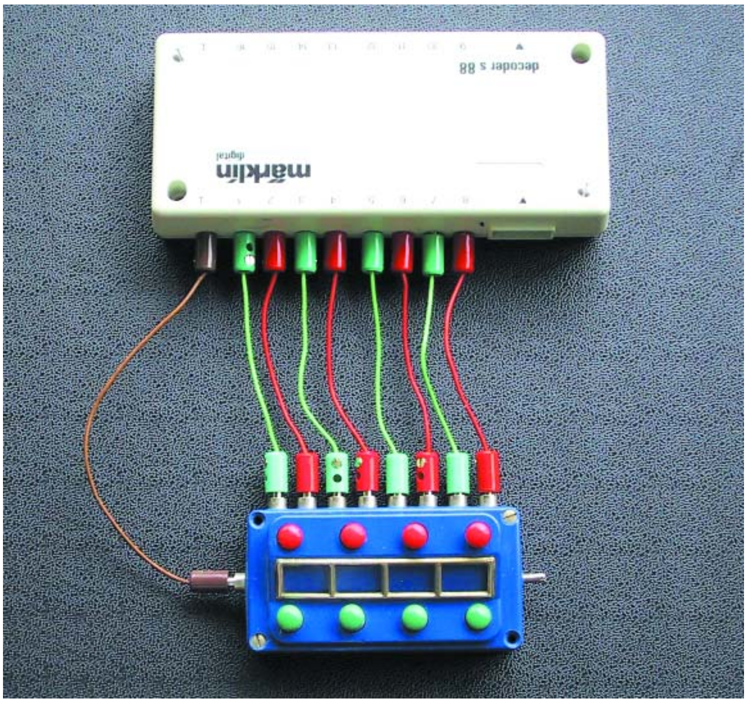


Figure 7. The Märklin 'keyboard' can serve perfectly well as an EEDTS Pro keypad.

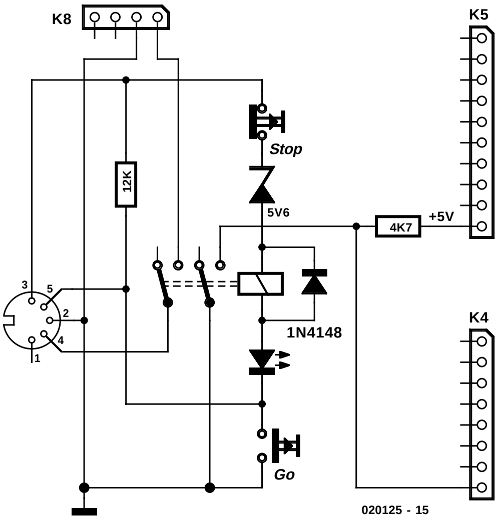


Figure 8. A booster interface with short circuit signalling via relay contacts.

successive addresses. One thing that might be somewhat annoying is that the numerical sequence of the S88 bus modules does not correspond to the output sequence of the turnout decoders. Consequently, we have provided a summary in **Table 1**.

EEDTS Pro short-circuit signaller

We conclude with a small hardware bonus. In order to advise the EEDTS Pro 1.2 software of the fact that there is a short circuit on the track, the dropping out of the relay in the booster interface is reported back to the master controller using the only remaining free pin of K4 (pin 8).

Whenever a short circuit occurs, the EEDTS Pro software will stop sending commands, and it will only resume sending data after the short circuit has been remedied and the interface relay has again been engaged.

Two alternative booster interfaces circuits are shown in **Figure 8** and **Figure 9**. The first one uses a relay with two electrically isolated make or changeover contacts. If all of the contacts of the available relay are already being used, the circuit shown in Figure 9 can be used instead.

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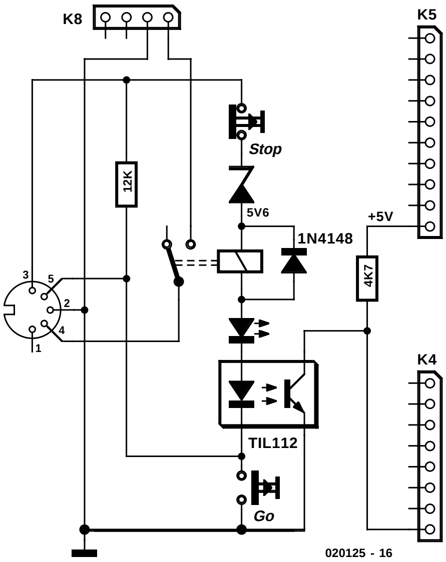

Figure 9. A booster interface with short circuit signalling via an optocoupler.

Table 1. Output sequence of the turnout/signal decoders.

EEDTS Pro train address detector 87291-8	Märklin S88 lower address	Märklin S88 upper address	EEDTS turnout/signal decoder 87291-1	Märklin turnout/signal decoder K83
7	8	16	1a	1 red
6	7	15	1b	1 green
5	6	14	2a	2 red
4	5	13	2b	2 green
3	4	12	3a	3 red
2	3	11	3b	3 green
1	2	10	4a	4 red
0	1	9	4b	4 green